Modelització i Simulació d'Altes Prestacions 2012/2013

Code: 42248
ECTS Credits: 6

Degree	Syllabus	Type	Year	Semester
4313133 Còmput d'Altes Prestacions, Teoria de la Informació i Seguretat / High Performance Computing, Information Theory and Security	1094 Còmput d'Altes Prestacions, Teoria de la Informació i Seguretat / High Performance Computing, Information Theory and Security	P	1	0
4313136 Modelització per a la Ciència i l'Enginyeria / Modelling for Science and Engineering	1095 Modelització per a la Ciència i l'Enginyeria / Modelling for Science and Engineering	O	3	0

Contact

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Use of languages

Principal working language: anglès (eng)

Prerequisites

A basic knowledge of programming languages is recommended.

Objectives and Contextualisation

General objectives: to introduce techniques used in modeling and simulation in different and multidisciplinary areas.

At the end of the module, students will be able to:

1.To analyze and develop a model to represent the equivalent of the real system.

2. To analyze and define the input data necessary to adapt them to the input requirements.

3. To select the methods of data analysis and output capabilities to define the functional procedures.

4. To design and develop simulation models using the above concepts and verify / validate the simulation tools according to scientific criteria.

Skills

- Analyse and evaluate parallel and distributed computing architectures, as well as develop and optimise advanced software for them.
- Apply the methodology of research, techniques and specific resources for investigating and producing innovative results in a certain specialised field.
- Direct innovation and research projects and work teams in the area of information theory, security and high performance computing.
- Possess and comprehend knowledge that offers the basis and opportunity to be original in the development and/or application of ideas, frequently in a research context.
- Recognise the human, economic, legal and ethical dimensions of professional exercise.
- Students must possess learning abilities to enable them to continue studying in a way that will to a large extent have to be self-managed and autonomous.

Learning outcomes

1. Apply the methodology of specific research, techniques and resources for investigating and producing innovative results in a certain specialised field
2. Identify the basic concepts and methodologies related to the development and management of research projects.
3. Possess and comprehend knowledge that offers the basis and opportunity to be original in the development and/or application of ideas, frequently in a research context
4. Recognise the human, economic, legal and ethical dimensions of professional exercise
5. Scientifically identify and relate the main elements of significant information for one's activity using developmental environments and tools for the creation of simulation models that serve one's needs
6. Solve multidisciplinary problems in the field of systems modelling and simulation.
7. Students must possess learning abilities to enable them to continue studying in a way that will to a large extent have to be self-managed and autonomous

Content

Section 1: Modelling
Introduction to modelling.
Representation of the model (model driven and data driven).
Classifications of models.
Type models based on the information used (heuristic, empirical).
Type models based on their scope (conceptual, mathematical).
Qualitative Models. Numerical Models.
Development, debugging, verification and validation of the model.
Development tools and test models.

Section 2: Simulation.
Introductory concepts of simulation.
Physical system and simulation.
Languages and simulation tools.
Design, development and debugging simulation models.
Complex simulation models.
Measuring performance.
High Performance Distributed Simulation: types, mechanisms, tools, use cases

Section 3: Analysis of simulation data.
Importance of analysis
Confidence intervals and the effect of correlation.
Analysis techniques applied to simulation data (variance, regression, chi square, cluster analysis, time series and data mining).
Methods Highlights: Replication and Batch Means
Applications and analysis of practical results.

Section 4: Introduction to numerical simulation
Introduction to computational techniques for numerical simulation.
Perspectives of different types of simulation for aeronautical, mechanical, electrical, chemical, and biological engineering and materials science.
Analysis of different types of tools and methods:
Mathematical formulations, network problems, techniques of direct and iterative matrix solution, Newton methods for nonlinear problems, discrete methods of differential equations, rapid methods for partial differential and integral equations, model reduction techniques.

Section 5: Cases of use.

a. Modelling and simulation of biologic systems

b. Simulation of social systems and health

c. Modelling and simulation of network systems

d. Invited Conference: external CEO of a company or institution where the use of simulation tools or environments are the main technique to solve the problems or to assist to the development.

Methodology

The methodology applied to the student work will combine master classes, laboratories, independent and assisted work of the students, and the presentation of a small project where students apply the received knowledge.

Distribution of the tasks:

Attending lectures and activities: 35%

Guided learning activities (outside classroom): 35%

Learning self-activities (outside classroom): 30% (individual).

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Lab sessions	6	0.24	1, 2, 5, 6
Main Lectures	24	0.96	1, 2, 3, 4, 5, 7
Type: Supervised			
Lab Sessions (S)	16	0.64	1, 6
Solving problems	6	0.24	2, 6
Type: Autonomous			
Personal work	31	1.24	1, 2, 3, 5, 6
Public presentation	10	0.4	3, 5, 6
Solving problems (group)	20	0.8	1, 5, 6
Solving problems (individually)	20	0.8	1, 6

Evaluation

The evaluation is divided in three parts: (1) a practical modelling work developed in the lab with Well Know simulation tools. (2) a research work on the subject of the module. (3) an experimental modelling work about some areas under study & public presentation of the developed solution.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Case study	30%	5	0.2	1
Experimental work	35%	6	0.24	6
Research work	35%	6	0.24	2, 5

Bibliography

1. Digital Computer Simulation. Maryanski, Fred. Hayden Book Co.
2. Multifaceted Modeling and Discrete Event Simulation. Zeigler, Bernard. Academic Press.
3. Systems Modeling & Computer Simulation. Keith, A. et al. 2nd Edition. Sept. 1995. Dekker, Inc. Publishers.
4. Parallel and Distributed Simulation Systems, Richard M. Fujimoto. Wiley
5. Parallel and Distributed Simulation of Discrete Event Systems in Handbook of Parallel and Distributed Computing, Alois Ferscha, McGraw-Hill.
6. Simulación para las Ciencias Sociales: Una guía práctica para explorar cuestiones sociales mediante el uso de simulaciones informáticas (2a. edición), McGraw-Hill.

Websites:

http://ccl.northwestern.edu/netlogo/

http://www.opnet.com/university_program/teaching_with_opnet/

http://www.cs.rpi.edu/~cheng3/dsim/

http://www.esa.int/TEC/Modelling_and_simulation/TECQ6CNWTPE_0.html

http://www.cc.gatech.edu/computing/pads/tech-parallel-gtw.html

http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-336j-introduction-to-numerical-simulati